FIG.1

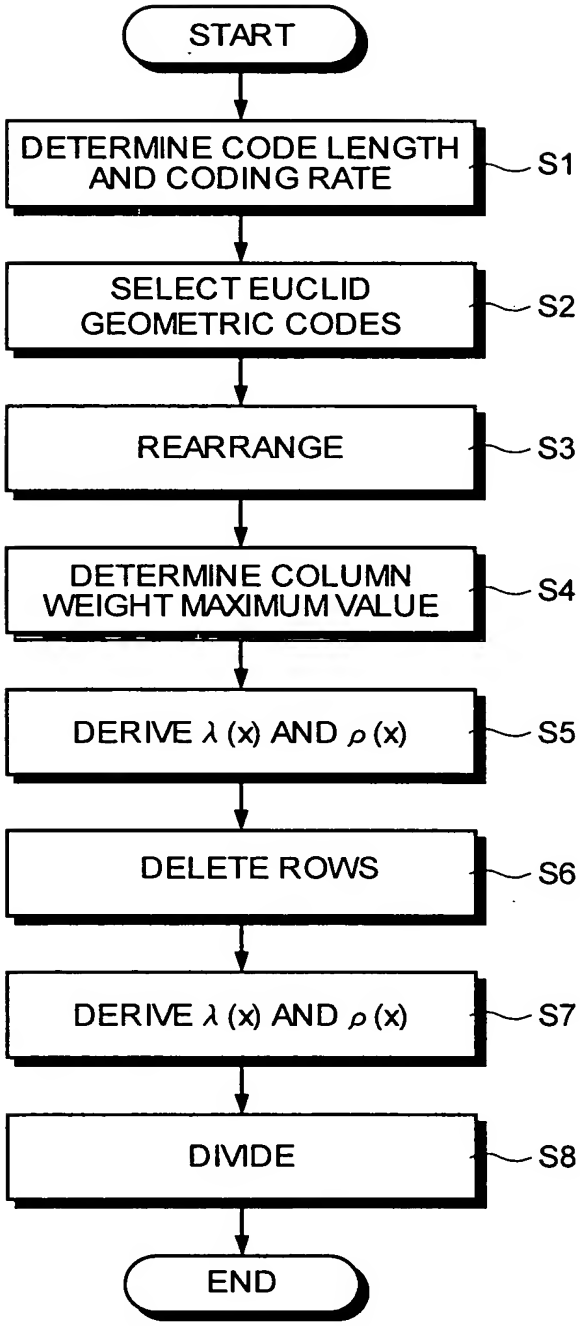
START
DETERMINE CODE LENGTH AND CODING RATE
S1
SELECT EUCLID GEOMETRIC CODES
S2
REARRANGE
S3
DETERMINE COLUMN WEIGHT MAXIMUM VALUE
S4
DERIVE λ (x) AND ρ (x)
S5
DELETE ROWS
S6
DERIVE λ (x) AND ρ (x)
S7
DIVIDE
S8
END

FIG.2

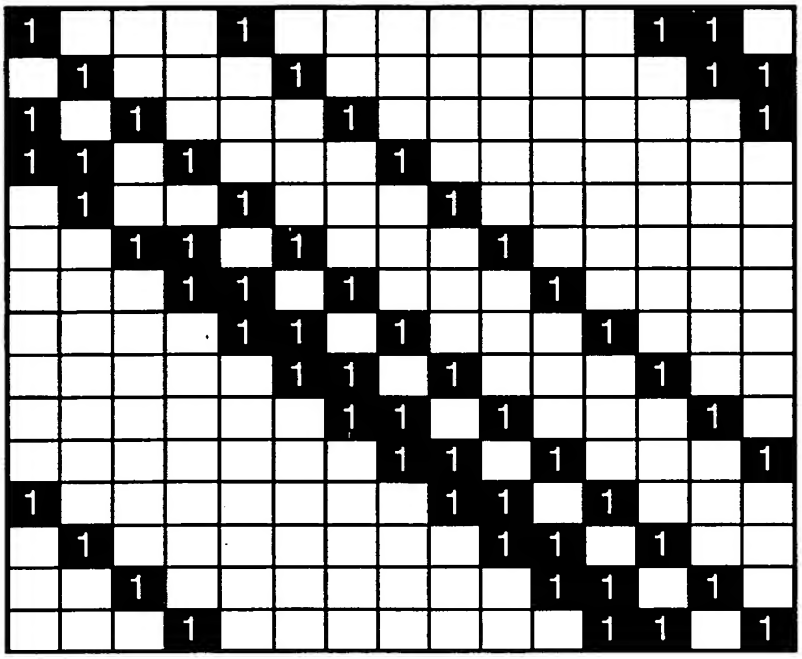

FIG.3

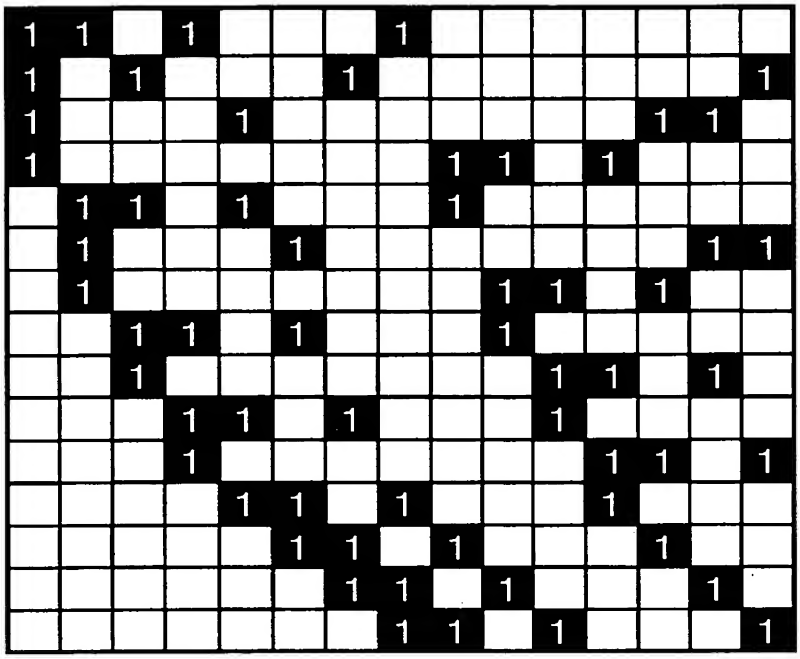
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1 1 1
1 1 1 1 1
1 1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1
1 1 1 1 1

FIG.4

d_l	12	
Rate	0.5	
	x	λ_x
	2	0.221354
	3	0.281879
	6	0.021475
	7	0.0001
	10	8.71E-05
	12	0.475104
	X	ρ_x
	8	0.92192
	9	0.07808
σ_{GA}	0.946711	
$SNR_{norm}(GA)$	0.2886dB	

FIG.5

d_l	12	
Rate	0.5	
	x	λ_x
	2	0.221354
	3	0.281879
	6	0.021475
	7	0.0001
	12	0.475104
	X	ρ_x
	8	0.92192
	9	0.07808
σ_{GA}	0.946736	
$SNR_{norm}(GA)$	0.2884dB	

FIG.6

d_l	12	
Rate	0.5	
	x	λ_x
	2	0.224033
	3	0.282078
	6	0.033481
	7	0.000166
	12	0.460242
	X	ρ_x
	8	1
σ_{GA}	0.947054	
$SNR_{norm}(GA)$	0.2855dB	

FIG.7

1	2	3	4	5	6	7	8	9	10	11
	x	Λ_x							x	λ_x
VARIABLE NODE (COLUMN)	2	0.224033399	5376.802	2688.401	2688	5376	5372	2686	2	0.223833333
	3	0.282077752	6769.866	2256.622	2257	6771	6777	2259	3	0.282375
	6	0.033481078	803.5459	133.9243	134	804	804	134	6	0.0335
	7	0.000166151	3.98762	0.56966	1	7	7	1	7	0.000291667
	12	0.46024162	11045.8	920.4832	920	11040	11040	920	12	0.46
TOTAL		0.582003275	24000	6000	6000	23998	24000	6000		1
	x	ρ_x							x	ρ_x
CHECK NODE (ROW)	8	1	24000	3000	3000	24000	24000	3000	8	1
		1	24000	3000	3000	24000	24000	3000		1
rate		0.500000001								0.5

• TOTAL NUMBER TP OF 1S WITHIN COLUMNS=(1023-273)x32=24000

FIG.8

d_l	12		
CODE LENGTH	6000		
	x	λ_x	No.
	2	0.223833	2686
	3	0.282375	2259
	6	0.0335	134
	7	0.000292	1
	12	0.46	920
	X	ρ_x	No.
	8	1	3000
σ_{GA}	0.946999		
$SNR_{norm}(GA)$	0.2860dB		

FIG.9

	1	2	3	4	5	6	7	8	9	10	11	12	13
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													

FIG.10

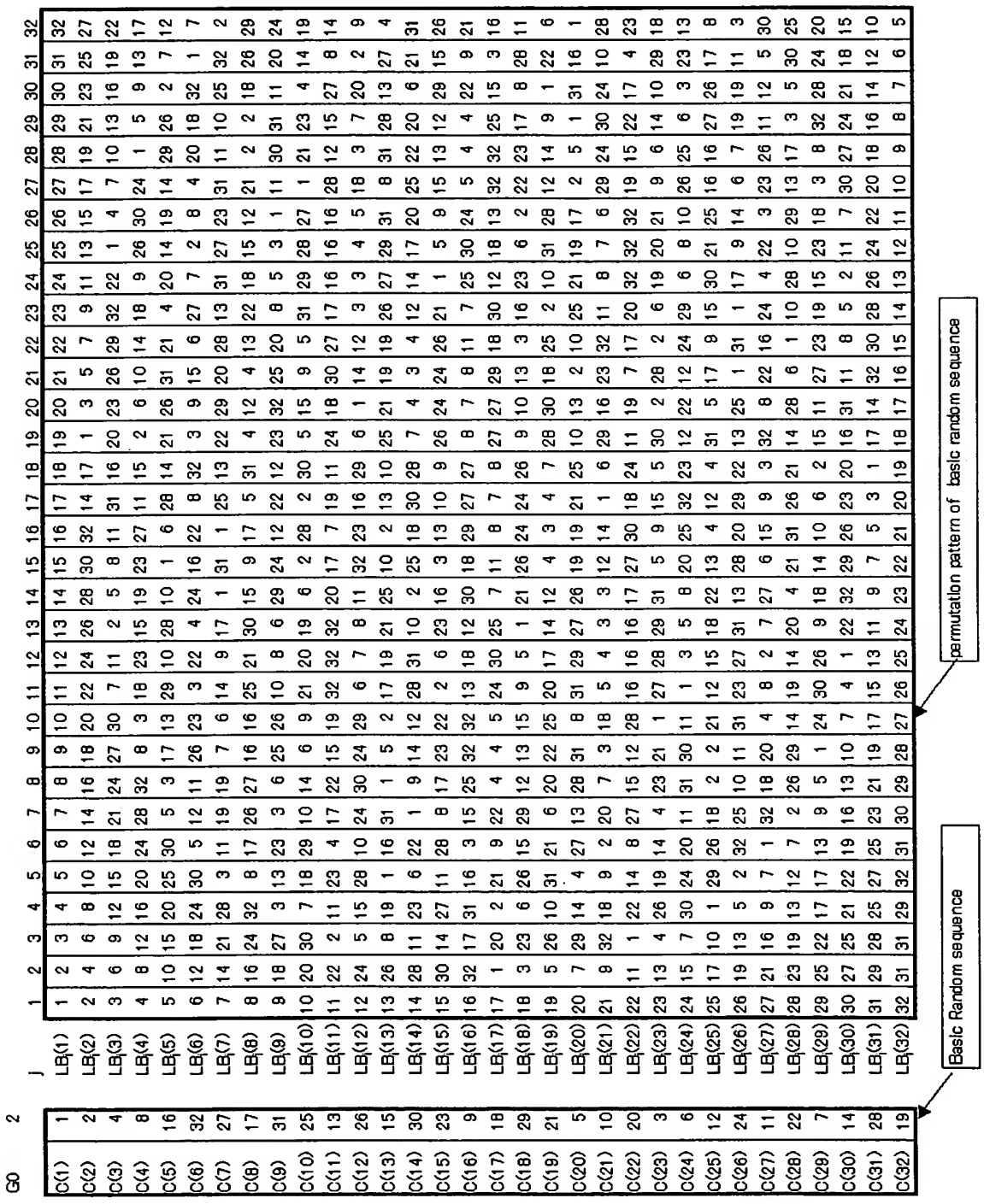
GO
2
J
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
C(1) 1 LB(1) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
C(2) 2 LB(2) 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 2 5 8 11 14 17 20 23 26 29 32 3 6 9 12 15 18 21 24 27
C(3) 4 LB(3) 3 6 9 12 15 18 21 24 27 30 7 11 2 5 8 11 31 16 20 23 26 5 9 32 3 6 10 14 17 21 25 28 31 22
C(4) 8 LB(4) 4 8 12 16 20 24 28 32 8 3 18 23 15 19 23 27 11 15 2 6 10 14 18 22 26 29 4 7 10 13 16 19 22 17
C(5) 16 LB(5) 5 10 15 20 25 30 5 3 17 13 29 10 28 10 1 6 28 14 21 26 31 21 4 20 24 27 1 4 7 11 14 17 20 12
C(6) 32 LB(6) 6 12 18 24 30 5 12 11 26 23 3 22 4 24 16 22 8 32 3 9 15 6 27 7 2 8 4 20 18 32 1 7
C(7) 27 LB(7) 7 14 21 28 3 11 19 19 7 6 14 9 17 1 31 1 25 13 31 4 12 28 13 31 27 23 31 11 10 25 32 2
C(8) 17 LB(8) 8 16 24 32 8 17 26 27 16 16 25 21 30 15 9 17 5 31 4 12 4 13 22 18 15 12 21 2 2 18 26 29
C(9) 31 LB(9) 8 18 27 3 13 23 3 6 25 26 10 8 6 29 24 12 22 12 23 32 25 20 8 5 3 1 11 30 31 11 20 24
C(10) 25 LB(10) 10 20 30 7 18 29 10 14 6 9 21 20 19 6 2 28 2 30 5 15 9 5 31 29 28 27 1 21 23 4 14 19
C(11) 13 LB(11) 11 22 2 11 23 4 17 22 15 19 32 32 32 20 17 7 19 11 24 18 30 27 17 16 28 12 15 27 8 14
C(12) 26 LB(12) 12 24 5 15 28 10 24 30 24 29 6 7 8 11 32 23 16 29 6 1 14 12 3 3 28 12 7 20 2 9
C(13) 15 LB(13) 13 26 8 19 1 16 31 1 5 2 17 18 21 25 10 2 13 10 25 21 19 19 26 27 8 28 13 4
C(14) 30 LB(14) 14 28 11 23 6 22 1 9 14 12 28 31 10 2 25 18 30 28 7 4 3 4 12 14 12 4 31
C(15) 23 LB(15) 15 30 14 27 11 28 8 17 23 22 2 6 23 16 3 13 10 9 26 24 24 26 21 1 5 9 15 13 12 28 15 26
C(16) 9 LB(16) 16 32 17 31 16 3 15 25 32 32 13 18 12 30 18 29 27 27 8 7 8 11 7 25 30 24 5 4 4 22 9 21
C(17) 18 LB(17) 17 1 20 2 21 9 22 4 4 5 24 30 25 7 11 8 7 8 27 29 18 30 12 18 13 32 32 25 15 3 16
C(18) 29 LB(18) 18 3 23 6 26 15 29 12 13 15 9 5 1 21 26 24 24 26 9 10 13 3 16 23 6 2 22 23 17 8 28 11
C(19) 21 LB(19) 19 5 26 10 31 21 6 20 22 25 20 17 14 12 4 3 4 7 28 30 18 25 2 10 31 28 12 14 9 1 22 6
C(20) 5 LB(20) 20 7 29 14 4 27 13 28 31 8 31 29 27 26 19 19 21 25 10 13 2 10 25 21 19 17 2 5 1 31 16 1
C(21) 10 LB(21) 21 9 32 18 9 2 20 7 3 18 5 4 3 3 12 14 1 6 29 16 23 32 11 8 7 6 29 24 30 24 10 28
C(22) 20 LB(22) 22 11 1 22 14 8 27 15 12 28 16 16 16 17 27 30 18 24 11 19 7 17 20 32 32 32 19 15 22 17 4 23
C(23) 3 LB(23) 23 13 4 26 19 14 4 23 21 1 27 28 29 31 5 9 15 5 30 12 22 2 6 19 20 21 9 6 14 10 29 18
C(24) 6 LB(24) 24 15 7 30 24 20 11 31 30 11 1 3 5 8 20 25 32 23 12 22 12 24 29 6 8 10 26 25 6 3 23 13
C(25) 12 LB(25) 25 17 10 1 29 26 18 2 2 21 12 15 18 22 13 4 12 4 31 5 17 8 15 30 21 25 16 16 27 26 17 8
C(26) 24 LB(26) 26 19 13 5 2 32 25 10 11 31 23 27 31 13 28 20 29 22 13 25 1 31 1 17 9 14 6 7 19 19 11 3
C(27) 11 LB(27) 27 21 16 9 7 1 32 18 20 4 8 2 7 27 6 15 9 3 32 8 22 16 24 4 22 3 23 26 11 12 5 30
C(28) 22 LB(28) 28 23 19 13 12 7 2 26 29 14 19 14 20 4 21 31 26 21 14 28 6 1 10 28 10 29 13 17 3 5 30 25
C(29) 7 LB(29) 29 25 22 17 17 13 9 5 1 24 30 26 9 18 14 10 6 2 15 11 27 23 19 15 23 18 3 8 32 28 24 20
C(30) 14 LB(30) 30 27 25 21 22 19 16 13 10 7 4 1 22 32 29 26 23 20 16 31 11 8 5 2 11 7 30 27 24 21 18 15
C(31) 28 LB(31) 31 29 28 25 27 25 23 21 19 17 15 13 11 9 7 5 3 1 17 14 32 30 28 26 24 22 20 18 16 14 12 10
C(32) 19 LB(32) 32 31 31 29 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5
permutation pattern of basic random sequence
Basic Random sequence

FIG.11

q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
$L_q(1)$	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9
$L_q(2)$	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10
$L_q(3)$	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16
$L_q(4)$	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24
$L_q(5)$	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25
$L_q(6)$	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28
$L_q(7)$	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23
$L_q(8)$	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5
$L_q(9)$	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8
$L_q(10)$	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12
$L_q(11)$	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31
$L_q(12)$	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14
$L_q(13)$	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30
$L_q(14)$	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21
$L_q(15)$	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4
$L_q(16)$	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6
$L_q(17)$	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17
$L_q(18)$	15	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7
$L_q(19)$	29	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15
$L_q(20)$	2	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29
$L_q(21)$	3	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2
$L_q(22)$	27	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3
$L_q(23)$	22	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27
$L_q(24)$	26	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22
$L_q(25)$	18	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26
$L_q(26)$	1	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18
$L_q(27)$	20	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1
$L_q(28)$	32	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20
$L_q(29)$	11	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32
$L_q(30)$	13	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11
$L_q(31)$	19	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13
$L_q(32)$	9	10	16	24	25	28	23	5	8	12	31	14	30	21	4	6	17	7	15	29	2	3	27	22	26	18	1	20	32	11	13	19

FIG.12

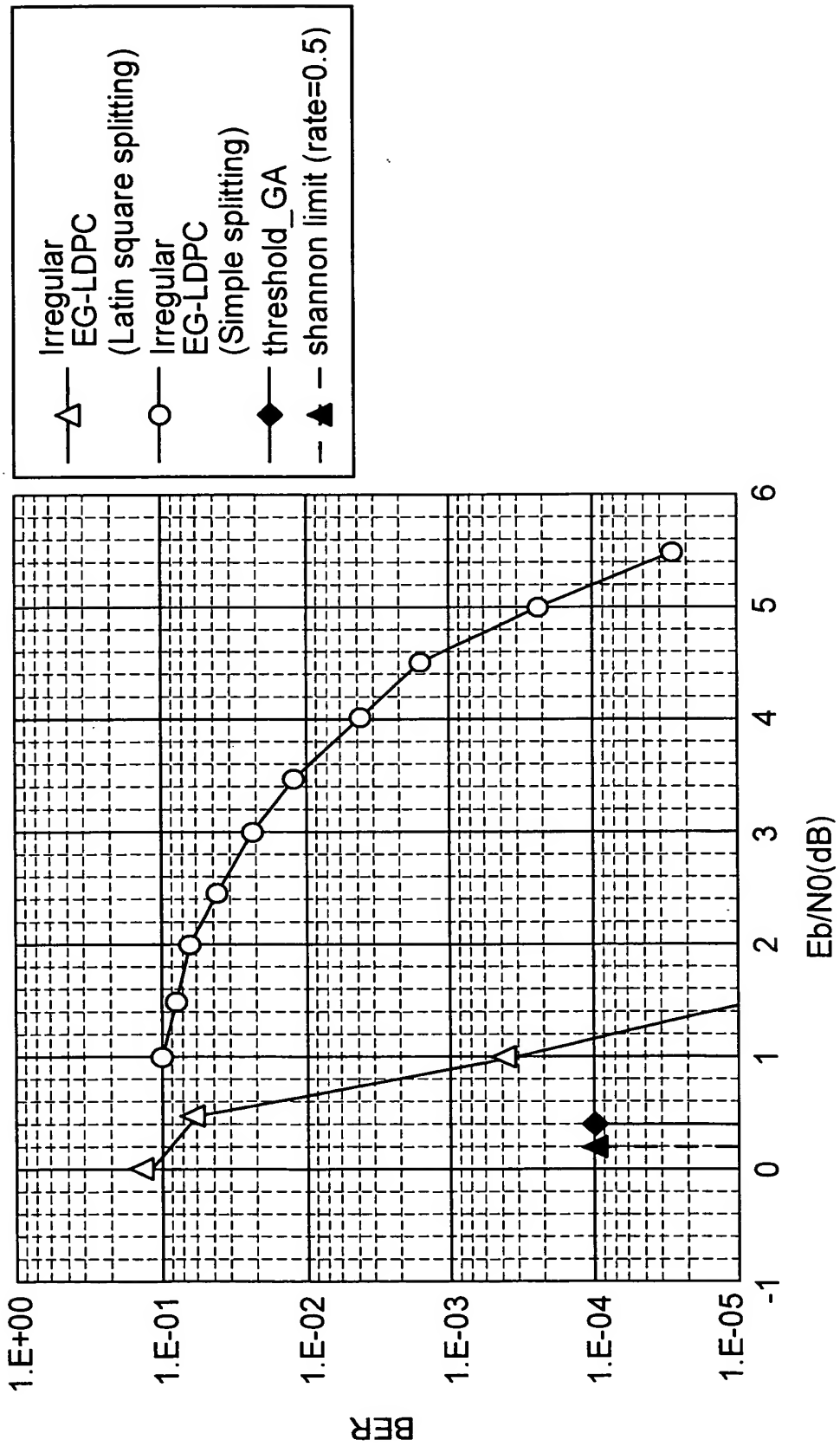
Irregular EG-LDPC (Latin square splitting)
Irregular EG-LDPC (Simple splitting)
threshold_GA
shannon limit (rate=0.5)
BER
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
-1
0
1
2
3
4
5
6
Eb/N0(dB)

FIG.13

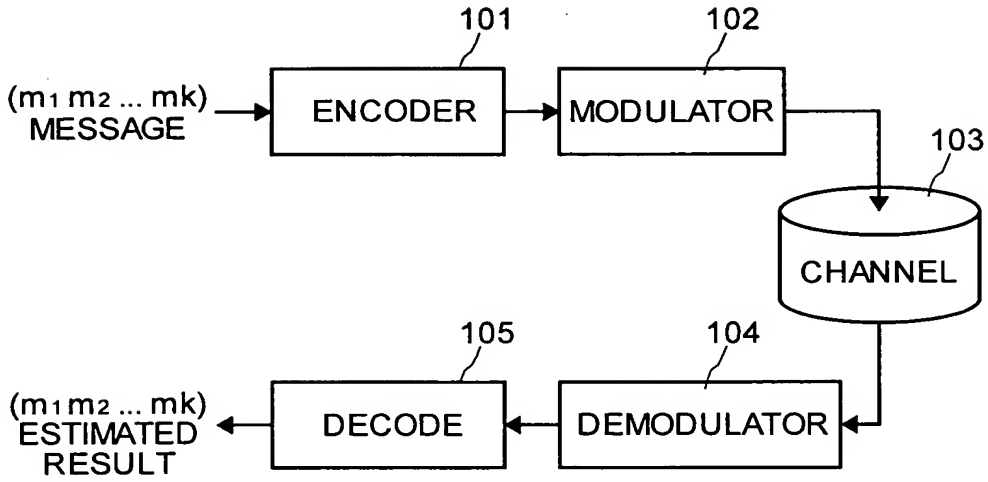
101
102
(m1 m2 ... mk)
MESSAGE
ENCODER
MODULATOR
103
CHANNEL
105
104
(m1 m2 ... mk)
ESTIMATED
RESULT
DECODE
DEMODULATOR

FIG.14

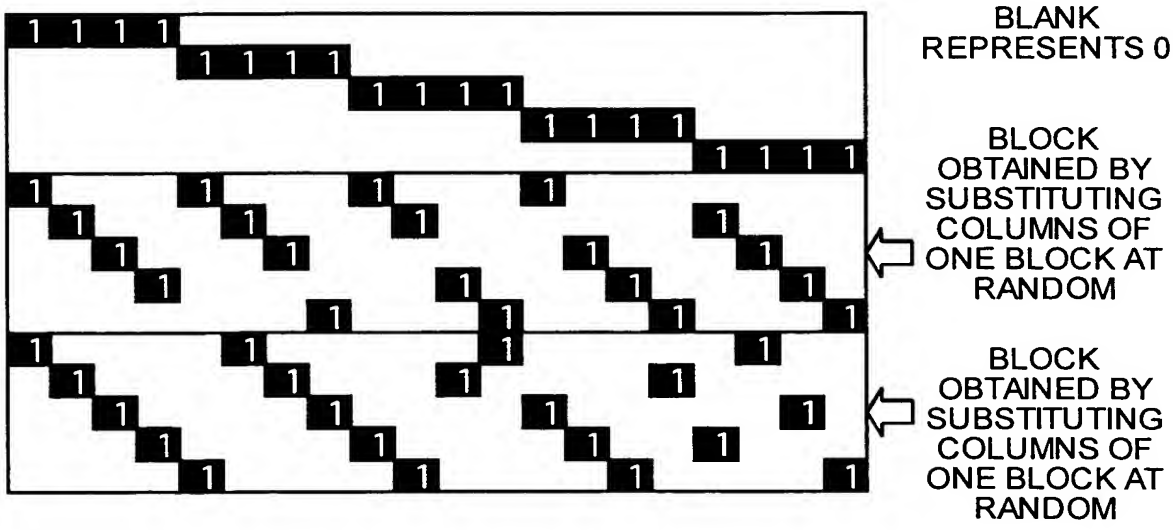
BLANK
REPRESENTS 0
BLOCK
OBTAINED BY
SUBSTITUTING
COLUMNS OF
ONE BLOCK AT
RANDOM
BLOCK
OBTAINED BY
SUBSTITUTING
COLUMNS OF
ONE BLOCK AT
RANDOM

FIG.15

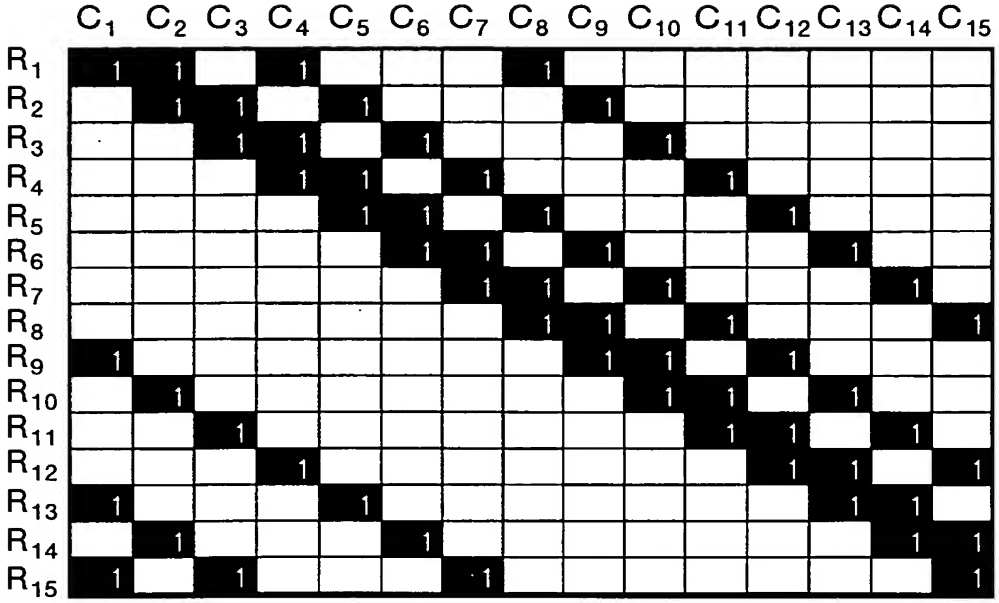

FIG.16